I. AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently amended) A triple-junction solar cell comprising:

a first cell layer comprising a germanium (Ge) substrate having a first and second diffusion regions doped with n-type dopants, wherein the second diffusion region diffuses deeper into the Ge substrate than the first diffusion region, wherein ~~the n-type dopants in~~ the first diffusion region has a higher concentration of ~~includes~~ phosphorus (P) atoms than arsenic (As) atoms and ~~having the highest dopant concentration and the n-type dopants in~~ the second diffusion region has a higher ~~includes arsenic (As) atoms having the highest dopant~~ concentration of As atoms than P atoms;

a nucleation layer disposed over the Ge substrate of the first cell layer;

a second cell layer comprising one of gallium arsenide (GaAs) and indium gallium arsenide (InGaAs) disposed over the nucleation layer; and

a third cell layer comprising indium gallium phosphide (InGaP) disposed over the second cell layer.

2. (Original) The triple-junction solar cell as recited in Claim 1 wherein the nucleation layer comprises a material having a lattice parameter substantially equal to the lattice parameter of the germanium substrate.

3. (Original) The triple-junction solar cell as recited in Claim 1 wherein the nucleation layer comprises InGaP.

4. (Original) The triple-junction solar cell as recited in Claim 1 wherein the nucleation layer has a thickness substantially equal to 350 Å or less.

5. (Previously presented) The triple-junction solar cell as recited in Claim 1, wherein the triple-junction solar cell is capable of absorbing radiation ranging from approximately ultraviolet (UV) radiation to radiation having a wavelength of approximately 1800 nm.

Claims 6-7. (Cancelled).

8. (Original) The triple-junction solar cell as recited in Claim 1 wherein the junction depth in the first cell layer is substantially between 0.3 μm and 0.7 μm.

9. (Original) The triple-junction solar cell as recited in Claim 1 wherein the first cell layer comprises a two-step diffusion profile capable of optimizing current and voltage generated therefrom.

10. (Original) The triple-junction solar cell as recited in Claim 1 having 1 sun AM0 efficiencies in excess of 26%.

11. (Currently amended) A triple-junction solar cell comprising:

a dual-junction structure comprising a first junction and a second junction;

a third junction having a p-type substrate, wherein the third junction <u>is</u> doped with arsenic (As) and phosphorus (P), wherein the p-type substrate includes [[a]] first and second diffusion sublayers, wherein at least a portion of the second diffusion sublayer is deeper into the p-type substrate than the first diffusion sublayer, wherein [[the]] P atoms have higher concentration compared to As <u>atoms</u> in the first diffusion sublayer and [[the]] As atoms have a higher concentration compared to P <u>atoms</u> in the second diffusion sublayer; and

a nucleation layer disposed between the dual-junction structure and the third junction and comprising a material that shares a substantially similar lattice parameter with the p-type substrate of the third junction, wherein the nucleation layer serves to control the diffusion depth of the third junction.

12. (Previously presented) The triple-junction solar cell as recited in Claim 11 wherein the p-type substrate of the third junction is germanium (Ge) and the nucleation layer comprises indium gallium phosphide (InGaP).

13. (Original) The triple-junction solar cell as recited in Claim 11 wherein the nucleation layer has a thickness substantially equal to 350 Å or less.

Claims 14-15. (Cancelled).

16. (Original) The triple-junction solar cell as recited in Claim 11 wherein the junction depth of the third junction is substantially between 0.3 μm and 0.7 μm.

17. (Original) The triple-junction solar cell as recited in Claim 11 wherein the third junction comprises a two-step diffusion profile capable of optimizing current and voltage generated from the third junction.

18. (Original) The triple-junction solar cell as recited in Claim 11 having 1 sun AM0 efficiencies in excess of 26%.

19. (Original) The triple-junction solar cell as recited in Claim 11 capable of absorbing radiation ranging from approximately ultraviolet (UV) radiation to radiation having a wavelength of approximately 1800 nm.

20. (Currently amended) A method for controlling the diffusion of a dopant into a substrate during a subsequent device process during the fabrication of a multi-layer semiconductor structure, the method comprising:

(a) disposing a nucleation layer over the substrate;

(b) performing the subsequent device process to form an overlying device layer containing the dopant, wherein the dopant[[s]] includes phosphorus (P) and arsenic (As), wherein the nucleation layer serves as a diffusion barrier to the dopant in the overlying device layer such that diffusion of the dopant into the substrate is limited by increasing the thickness of the nucleation layer, wherein

the performing the subsequent device process further includes diffusing P atoms to a shallow diffusion region and diffusing As atoms to a deep diffusion region of the substrate.

21. (Original) The method as recited in Claim 20 wherein the nucleation layer comprises a material that shares an identical lattice parameter with the substrate.

22. (Original) The method as recited in Claim 20 wherein the substrate is germanium (Ge) and the nucleation layer comprises InGaP.

23. (Original) The method as recited in Claim 20 wherein the nucleation layer has a thickness substantially equal to 350 Å or less.

Claims 24-25. (Cancelled).

26. (Previously presented) The method as recited in Claim 20 wherein a two-step diffusion profile is achieved in an n-p junction formed in the substrate.

27. (Original) The method as recited in Claim 20 wherein the subsequent device process includes metal organic chemical vapor deposition (MOCVD).

28. (Original) The method as recited in Claim 20 wherein the nucleation layer also serves as a source of the dopant for forming an n-p junction in the substrate.

29. (Original) The method as recited in Claim 20 wherein diffusion of the dopant into the substrate primarily involves solid state diffusion.

30. (Original) The method as recited in Claim 29 wherein diffusion of the dopant into the substrate also involves gas phase diffusion during oxide desorption.

31. (Currently amended) A method for fabricating a multi-layer semiconductor structure, the method comprising:

(a) preparing a germanium (Ge) substrate layer for doping by a dopant, wherein the dopant[[s]] includes phosphorus (P) atoms and arsenic (As) atoms;

(b) disposing a nucleation layer over the germanium substrate layer;

(c) disposing a middle layer comprising the As atoms over the nucleation layer, wherein the disposing a nucleation layer further includes controlling diffusion of the P atoms into a first diffusion sublayer and diffusion of the As atoms into a second diffusion sublayer, wherein the first diffusion sublayer is substantially adjacent to the nucleation layer and the second diffusion sublayer is adjacent to the first diffusion sublayer; and

(d) disposing a top layer comprising indium gallium phosphide (InGaP) over the second tunnel junction, wherein the nucleation layer serves as a diffusion barrier such that diffusion of the dopant into the germanium substrate can be limited by increasing the thickness of the nucleation layer.

32. (Original) The method as recited in Claim 31 wherein the nucleation layer comprises a material having a lattice parameter substantially equal to the lattice parameter of the germanium substrate.

33. (Original) The method as recited in Claim 31 wherein the nucleation layer comprises InGaP.

34. (Original) The method as recited in Claim 31 wherein the nucleation layer has a thickness substantially equal to 350 Å or less upon completion of said step (b).

Claims 35-36. (Cancelled).

37. (Previously presented) The method as recited in Claim 31wherein a junction depth in the germanium substrate layer is substantially between 0.3 μm and 0.7 μm upon completion of said steps (a) through (d).

38. (Currently amended) A multi-junction solar cell comprising:

a p-type germanium (Ge) substrate having a first surface, wherein the p-type Ge substrate further includes ~~a diffusion portion having~~ a first diffusion sublayer situated adjacent to the first surface of the p-type Ge substrate and a second diffusion sublayer situated adjacent to the first diffusion sublayer;

an indium gallium arsenide (InGaAs) nucleation layer disposed over the first surface of

the p-type Ge substrate, wherein the InGaAs nucleation layer provides n-type phosphorus (P) atoms to the first diffusion sublayer, wherein the first diffusion sublayer has a higher concentration of P atoms than arsenic (As) atoms; and

a Gallium Arsenide (GaAs) buffer layer ~~including arsenic (As) atoms~~ disposed over the InGaAs nucleation layer, wherein the GaAs buffer layer provides n-type As atoms to the second diffusion sublayer in response to the thickness of the InGaAs nucleation layer.

39. (Original) The multi-junction solar cell of claim 38, further comprising a second surface situated at the bottom of the multi-junction solar cell.

40. – 42. (Canceled).

43. (Currently amended) The multi-junction solar cell of claim 38[[42]], wherein ~~the As atoms in~~ the second diffusion sublayer has a higher ~~the highest dopant~~ concentration of As atoms than P atoms.

44. (Currently amended) A multi-junction solar cell comprising:

a p-type germanium (Ge) substrate having a first surface, wherein the p-type Ge substrate further includes a diffusion portion having a first diffusion region situated adjacent to the first surface of the p-type Ge substrate and a second diffusion region, which includes a part of all of the first diffusion region, wherein the second diffusion region diffuses deeper into the Ge substrate than

the first diffusion region;

a phosphorus (P) containing nucleation layer disposed over the first surface of the p-type Ge substrate, wherein the P containing nucleation layer provides n-type ~~phosphorus (P)~~ P atoms to the first diffusion region; and

an arsenic (As) containing buffer layer ~~including arsenic (As) atoms~~ disposed over the P containing nucleation layer, wherein the As containing buffer layer [[of GaAs]] provides n-type As atoms to the second diffusion region in response to the thickness of the P containing nucleation layer, wherein the second diffusion region has a higher concentration of As atoms than P atoms.

45. (Original) The multi-junction solar cell of claim 44, further comprising a second surface situated at the bottom of the multi-junction solar cell.

46. (Currently amended) The multi-junction solar cell of claim 44, wherein the first diffusion region ~~includes the P atoms and As atoms; wherein the P atoms in the first diffusion region~~ has a higher ~~the highest dopant~~ concentration of P atoms than As atomes.

47. – 48. (Canceled).

49. (Currently amended) A multi-junction solar cell comprising:

a germanium (Ge) substrate having ~~a first surface, wherein the substrate further includes a diffusion portion having~~ a first diffusion region ~~situated adjacent to the first~~

~~surface of the substrate~~ and a second diffusion region, ~~which includes a part of all of the first diffusion region,~~ wherein the second diffusion region diffuses deeper into the Ge substrate than the first diffusion region;

a phosphide nucleation layer disposed over the first surface of the substrate, wherein the phosphide nucleation layer provides diffusion dopants of phosphorus (P) atoms to the first diffusion region; and

an arsenide layer ~~having arsenic (As) atoms~~ disposed over the phosphide nucleation layer, wherein the arsenide layer provides diffusion dopants of arsenic (As) [[As]] atoms into the second diffusion region in response to the thickness of the phosphide nucleation layer, wherein the first diffusion region has a higher concentration of P atoms than As atoms.

50. (Original) The multi-junction solar cell of claim 49, further comprising a second surface situated at the bottom of the multi-junction solar cell.

51. (Canceled).

52. (Currently amended) The multi-junction solar cell of claim 49, wherein the second diffusion ~~region includes the P atoms and As atoms, wherein the As atoms in the second diffusion region~~ has a higher ~~the highest dopant~~ concentration of As atoms than P atoms.

53. (Canceled).